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Art. VI.—*On an Ostracod and Shell Marl of Pleistocene Age from Boneo Swamp, West of Cape Schanck, Victoria.*

By FREDERICK CHAPMAN, A.L.S., F.R.M.S.

(With Plates III. and IV).

[Read 10th July, 1919].

Description of Deposit.

The dried marl is of a whitish-grey colour, but when wet is grey to smoke-brown. It is light in weight and cavernous in places, the holes being due to the roots and stems of plants, which have been enclosed in the deposit.

The molluscan shells are mainly of freshwater types, belonging to the genera *Bullinus* and *Coxiella*, but the marine genus, *Erycina*, is also well represented.

Ostracoda are chiefly of aquatic character, as *Cypris* and *Candonopsis; Limnicythere* is a genus which is usually found in streams and lakes, draining high land, and in close proximity to the sea; *Cythere* (*C. lubbockiana*), though rare in this deposit, is a true marine ostracod.

Under a high power of the microscope the fine washings are seen to consist of minute rounded particles mingled with fragments of ostracoda, and a few freshwater diatoms (*Cymbella*). This genus of diatomaceae has been previously recorded from several Victorian localities of Pleistocene age, in deposits of a freshwater or lacustrine nature, as those of Mickleham (det. by author), Eglinton, Amherst, Coralulup, Splitter's Creek, Rodborough, Belfast and Talbot.[1]

The material is almost purely calcareous. On testing it for phosphoric acid, no reaction was obtained.

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[1] See Mahony, D. J. Bull, Geol. Surv. Vict., No. 26. 1912. pp. 12, 15 and 16.

Description of Fauna.

PHYLUM MOLLUSCA.

Class PELECYPODA.

Fam. LEPTONIDAE.

Genus ERYCINA, Lamarck.

Erycina helmsi, Hedley. (Plate III., Figs. 1, 2.)

Erycina helmsi, Hedley, 1915, Proc. Linn. Soc., N.S. Wales, vol. XXXIX., pt. IV., p. 701, pl. LXXX. Figs. 37-39. Chapman and Gabriel, 1917, Proc. R. Soc. Vict., vol. XXX. (N.S.), pt. I., p. 6.

Observations.—It is interesting to meet with this little bivalve in these sub-fossil deposits, in which the majority of forms are of freshwater habitat. The localities where it is found living are Dee Why Lagoon, New South Wales; and in Victoria, at Port Melbourne, Corio Bay, Altona Bay, Port Albert and Lakes Entrance. Mr. C. J. Gabriel and the author also recorded it (loc. supra cit.) from the Pleistocene deposits underlying volcanic tuff near Warrnambool, where it occurred abundantly in association with many marine shells and a few brackish water forms. Some specimens from Lake Connewarre, near Geelong, in the Dennant collection, labelled "*Pisidium etheridgei*," also belong to the above species. At first glance, this small form might easily be mistaken for the aquatic genus, *Pisidium*, but an examination of the hinge-line is sufficient to show the difference.

Occurrence.—Common in the Boneo Swamp deposit.

Class GASTEROPODA.

Fam. TRUNCATELLIDAE.

Genus COXIELLA, E. A. Smith.

Coxiella striatula, Menke sp. (Plate III., Fig. 3.)

Truncatella striatula, Menke, 1842, Moll. Nov. Holl., p. 9.

Blanfordia pyrrhostoma, Cox, 1868, Mon. Austr. Land Shells, p. 95, pl. XV., Fig. 14.

Pomiatopsis striatula, Menke sp. Tenison Woods, 1876, Proc. Roy. Soc. Tas. for 1875, p. 78.

Coxiella striatula, Menke sp., E. A. Smith, 1898, Proc. Malac. Soc., vol. III. p. 75.

Coxiella confusa, E. A Smith, 1898, Ibid. p. 76.

Coxiella striatula, Menke sp., Hedley, 1916, Prelim. Index. Moll. W. Austr., p. 189.

Observations.—Some of the shells of this freshwater or brackish lacustrine species have as many as six whorls. The periostracum having been removed by natural decay, the ornament is clearly seen as a longitudinal striation with occasional stronger varicial striae, crossed by finer lineations. The young examples of about three whorls are not decollated, the protoconch showing as a smooth depressed spiral of about one and a-half whorls.

The cleaned surfaces of the shells point to a slight age for this deposit, although it should be borne in mind that the margins of some swamps where this species abounds are covered with layers of the shells in this condition.

C. striatula is a very widely distributed form in Australia.

Occurrence.—Common in the Boneo Swamp deposit.

Fam PLANORBIDAE.

Genus BULLINUS, Oken.

Bullinus acutispira, Tryon, sp. Plate III., Fig. 4.

Physa acutispira, Tryon, 1866, Amer. Journ. Conch. vol. II. p. 9, pl. II., Fig. 10. Tate and Brazier, 1881, Proc. Linn. Soc. N.S. Wales, vol. VI., p. 557. Smith, 1882, Journ. Linn. Soc. Lond. Zool., vol. XVI. p. 282, pl. VI., Fig. 16. Clessin, 1885, Conch. Cab., vol. I. pt. 17, p. 242, pl. XXXIV., Fig. 1.

Bullinus acutispira Tryon sp., Hedley, 1917, Rec. Austr. Mus., vol. XII., No. 1, p. 5, pl. I., Figs. 11-13.

Observations.—The present speciments of these freshwater shells from Boneo Swamp are of thicker build than the var. *yarraensis*, T. Woods.[2] and are therefore referred to the type species.

Bullinus tasmanicus, T. Woods sp.[3] closely resembles the above species, but the apex is not so acute, nor is the aperture so open. The species and variety have been recorded from Horsham, Cape Grant, near Portland, Yan Yean Reservoir, Bunyip River, and Carrum Creek, Frankston. One of the Boneo Swamp specimens has an elongated spire, and resembles the figured specimen of Hedley's, from Horsham.

Occurrence.—This specimen is fairly numerous in the Boneo Swamp material.

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[2] *Physa yarraensis*, T. Woods, Proc. Roy. Soc. Vict. Vol. XIV., 1878, p. 64. *Bullinus acutispira*, Tryon, sp., var. *yarraensis* T. Woods var. Hedley, 1917, Rec. Austr. Mus., Vol. XII., No. 1, p. 5. pl. II., Fig. 16.

[3] *Physa tasmanica*, T. Woods, Proc. R. Soc. Tasmania, for 1875 (176), p. 74. *Bullinus tasmanicus*, T. Woods, sp. Chapman. Mem. Nat. Mus., Melbourne, No. 5, 1914, p. 58, pl. I., Figs. 5, 5*a*.

Class CRUSTACEA.

Super-order OSTRACODA.

Fam. CYPRIDAE.

Genus CYPRIS, Müller.

Cypris mytiloides, G. S. Brady. (Plate III., Figs. 5, 5*a*.)

Cypris mytiloides, G. S. Brady, 1886, Proc. Zool Soc. Lond. p. 89, pl. IX., Figs. 1-3.

Observations—This species was first described from Kangaroo Island, S. Australia. It is a well known living form in Victorian swamps and lakes, and I have examples from the Yering Flats, near Lilydale.

The carapace of *C. mytiloides*, seen laterally, appears to be generally rather broader than in the majority of living specimens, but this difference is only sub-varietal. Average length of carapace, 3.2 mm.; breath, 1.4 mm., The type specimen of Dr. Brady, supplied by Prof. Tate, has a length of 5 mm.

Occurrence.—In the Boneo Swamp deposit this species is very abundant.

Cypris sydneia, King. Plate IV., Figs. 6, 6*a*.

Cypris sydneia, King, 1855, Proc. R. Soc. Tasmania, vol. III., pt. I. p. 65, pl. X. Fig. M.

Cypris ciliata, Thomson, 1879, Trans. N.Z. Inst., vol. XI. p. 253, pl. XI. Fig. A, I*a-g*.

Cypris sydneia, King, G. O. Sars, 1894, Vidensk, Selsk, Skrifter. I. Math. Nat. Kl. No. 5, p. 27, pl. IV., Figs, 2*a-c*. Id., 1896, Freshwater Entom. from neighbourhood of Sydney, Kristiania (Alb. Cammermeyers Forlag), p. 50.

Observations.—*C. sydneia* was originally described from specimens taken in a swamp near Woolloomooloo Bay, Sydney, and Mr. Whitelegge collected it from Bourke Street, Sydney. The New Zealand localities are—lagoons in the neighbourhood of Dunedin; a pond at Eyreton, North Canterbury district; ditches at Kaitaia, N. Island.

The present examples are quite typical, and the shape and position of the muscle-spots agree with the figures given by Sars, of the New Zealand specimens. The surface of the shell is sparsely punctate, and from each punctum there is a faint stria directed posteriorly.

Occurrence.—This freshwater species is fairly abundant in the Boneo Swamp deposit.

Cypris tenuisculpta sp. nov. (Plate IV., Figs. 7, 7*a*, *b*.)

Description.—Valve seen from the side, subreniform, highest in front, narrowing slightly to the posterior. Edge view subovate, moderately tumid, more compressed anteriorly. Valves slightly unequal. Dorsal margin roundly angulate near the middle, directly sloping to the extremity. Both ends evenly rounded. Ventral margin incurved at the middle, and curving outwards to meet the evenly rounded anterior border; the latter having a narrow depressed margin. Surface of shell finely but distinctly sculptured with closely set longitudinal and anastomosing raised lines.

Length, 1.3 mm.; greatest width, 0.77 mm.

Observations.—This species closely resembles *Cypris lateraria*, King,[4] especially in the figures given by G. O. Sars[5] from the Sydney examples. The chief difference lies in the superficial sculpture, which in the present species is finely lineate, *C. lateraria* having a granulose surface with scattered tubercles.

Occurrence.—Common in the Boneo Swamp deposit.

Candonocypris assimilis, G. O. Sars. Plate IV., Figs, 8, 8*a*.

Candonocypris assimilis, G. O. Sars, 1894, Contrib. knowledge Freshwater Entom. N, Zealand, Vidensk, Selsk, Skrifter, I. Math. Kl. No. 5, p. 36, pl. V., Figs. 2*a-c*.

Observations.—In outline, seen from the side and above, the fossil specimens perfectly agree with Sars' New Zealand species, which is a freshwater form. The valves are slightly unequal, as seen in at least one of the complete carapaces in the present collection, and the muscle-spots number 7, with 2 arranged slightly forward and below the others. The surface of the shell is marked with excessively fine, elongate reticulae and a few punctations.

The writer would be inclined to place under the above genus Brady's *Cypris viridula*,[6] of which the above appears to be a fuscous variety. The straight dorsal border figured by Dr. Brady is not always represented, and in other ways, as in the thicker carapace, it seems to be distinct from *Ilyodromus*, in which genus G. O. Sars has more recently placed it.

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[4] *Cypris lateraria*, King, Proc. R. Soc., Tasmania, Vol. III., pt. I., 1855, p. 65, pl. X., G. G.

[5] G. O. Sars, 1896. On Freshwater Entom., from the neighbourhood of Sydney, partly raised from dried mud, Kristiania. p. 53, pl. VII., Figs. 3*a-c*.

[6] Proc. Zool. Soc. Lond., 1886, p. 88, pl. VIII. Figs 1, 2.

Sars' specimens were hatched from dried mud taken from lagoons in the neighbourhood of Dunedin. A female measures 1.6 mm. in length. The present examples have a length of about 1.4 mm.

Occurrence.—Abundant in the Boneo Swamp material.

Fam. CYTHERIDAE.

Genus CYTHERE, Müller.

Cythere lubbockiana, G. S. Brady. Plate IV., Fig. 9.

Cythere lubbockiana, G. S. Brady, 1880, Rep. Chall. vol. I. pt. III. Zool. p. 68, pl. XIV., Figs, 6*a-d*. Chapman, 1914, Proc. R. Soc. Vict. vol. XXVII. (N.S.), pt. I. p. 36, pl. VII., Fig. 17.

Observations.—The present example of this marine ostracod appears to be typical in all essentials as form, outline and ornament, with a minor exception that the pittings are replaced by smaller punctuation, as in *C. acupunctata*, Brady.[7] As a living species, it is recorded from Booby Island, Torres Strait, in 6-8 fathoms.

Fossil specimens have been recorded by the writer from the Miocene and Pliocene of the Mallee bores, the deepest being 542 feet from the surface; these Miocene deposits, by the way, have been formed in about 100 fathoms.

It is interesting to note the above species under such widely differing circumstances as to age, depth and geographical position. Although not yet recorded from coastal dredgings round Victoria, *C. lubbockiania* probably occurs in its shallow depths; and in times not far distant, this and its allies, along with the marine bivalve, *Erycina helmsi*, were washed in by tidal currents.

Occurrence.—One left valve found in the Boneo Swamp deposits.

Limnicythere sicula, sp. nov. Pl. IV., Figs. 10, 11.

Description.—Valves very small; seen from the side, subrectangular, expanded anteriorly. Hinge-line long and straight; ventral border incurved in the middle. Anterior margin depressed, with a broad border marked with radial lines; posterior with a narrow depressed margin. Seen from above, carapace ovate, compressed at the extremities, with a hooked process prominent in the median area. Rising from the middle of each valve, a little in front and towards the ventral margin, the hooked process is seen to curve towards the dorsal border. Below this, nearer the ventral margin, is a rounded prominence or tubercle, and near the dorsal margin, anteriorly and medially are two others, Superficial ornament consists of fine reticulae or pittings scattered closely over the larger part of the valves.

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[7] *Cythere acupunctata*, Brady, Rep. Chall. Vol. I., Pt. III. Zool. 1880. p. 68, pl. XIV., Figs. 1*a-h*.

Length, .38 mm.; greatest width, .3 mm.; thickness of carapace, .27 mm.

Observations.—None of the northern species very closely approach the above form, the nearest being *L. monstrifica*, Norman sp.,[8] found living round England, and Pleistocene in the Lincolnshire Fens. This has two large spinous processes, with several smaller spines and ridges. Undoubtedly the nearest allied species is the *Limnocythere mowbrayensis*, Chapman,[9] which the writer recently described from Mowbray Swamp, near Smithton, N.W. Tasmania. In this species, the lateral processes are not so produced, the tubercles differently spaced, whilst the anterior border is not so deep nor broad. Moreover, it attains a larger size than the present species.

Occurrence.—This very minute species is excessively abundant in the Boneo Swamp deposit.

General Remarks and Summary.

An examination of the swamp deposit from this locality in the Schanck Peninsula affords some interesting points for comment. Probably in late Pliocene times, and on to Pleistocene, this area was connected with Tasmania. The immediate progenitors of the freshwater mollusca and ostracoda found in the Boneo deposit must have been living in dune and swamp country, which no doubt extended across Bass Strait. We can conceive this country then connected by way of a chain of swamps running from the

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[8] *Cypris monstrifica*, Norman, Ann. Mag. Nat. Hist., Vol. IX., 1862, p. 45, pl. III., Figs. 4, 5. *Limnicythere monstrifica*, Norman sp. Brady, Mon. Rec. Brit. Ostrac., 1868, p. 420, pl. XXIX., Figs. 9-12.

[9] Mem. Nat. Mus., Melbourne, No. 5, 1914, p. 60, pl. II. Figs. 8*a*-*c*.

N.W. corner of Tasmania passing northwards to the east of King Island, and joining with the Cape Schanck area.[10]

That there is a slight antiquity to be ascribed to the Boneo deposit seems to be shown by the presence of marine shells, for the existing conditions would appear to preclude their penetration so far inland, unless perhaps by an abnormally high tide. No doubt the actual conditions at the time of deposition were those of tidal swamps, such as may be seen in the coastal lakes of the Ninety Mile Beach in Gippsland.

This marl is not phosphatic, as might be supposed from the abundant remains of ostracoda. An explanation of this may be found in the fact that those forms which do occur are all thin-shelled, and of the more purely calcareous type of freshwater genera.

The organic remains found in this marl are:—

Pelecypoda.	*Erycina helmsi*, Hedley.
Gasteropoda.	*Coxiella striatula*, Menke sp.
	Bullinus acutispira, Tryon sp.
Ostracoda.	*Cypris mytiloides*, G. S. Brady.
	,, *sydneia*, King.
	,, *tenuisculpta*, sp. nov.
	Candonocypris assimile, G. O. Sars.
	Cythere lubbockiana, G. S. Brady.
	Limnicythere sicula, sp. nov.

EXPLANATION OF PLATES.

Plate III.

Fig. 1.—*Erycina helmsi*, Hedley. Left valve. × 10.
,, 2.—*E. helmsi*, Hedley. Interior of left valve of another specimen. × 10.
,, 3.—*Coxiella striatula*, Menke sp.
,, 4.—*Bullinus acutispira*, Tryon sp. × 5.
,, 5.—*Cypris mytiloides*. G. S. Brady. Right valve. 5*a*, ventral edge view of the same. × 26.

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[10] In Dr. F. Noetling's paper on the Antiquity of Man in Tasmania (Proc. R. Soc., Tasmania, 1910), that author, on plate I., Fig. 6, shows the Tasmania-Victorian coastal contours, as would appear from an uplift of 40 fathoms of the present sea bottom in the Strait. The tongue of land thus brought up would form a direct connection from the Smithton (N.W. Tasmania) district to the Boneo (Cape Schanck) locality, and this view helps considerably to explain the theory here advanced, that the Boneo fluviatile fauna was, in part at least, derived from a Tasmanian one.

PLATE IV.

Fig. 6.—*Cypris sydneia*, King. Right valve, showing muscle-spots, 6*a*, ventral edge view. × 26.

,, 7.—*Cypris tenuisculpta*, sp. nov. Right valve, × 26. 7*a*, ventral edge view of carapace, × 26. 7*b*, magnified view of ornament. × 78.

,, 8.—*Candonocypris assimile*, G. O. Sars. Left valve, showing muscle-spots. 8*a*, ventral aspect of carapace. × 26.

,, 9.—*Cythere lubbockiana*, G. S. Brady. Left valve. × 52.

,, 10.—*Limnicythere sicula*, sp. nov. Right valve. × 52.

,, 11.—*L. sicula*, sp. nov. Edge view, dorsal aspect. × 52.